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Agricultural Research Service

REPORT OF WORKSHOP

Semiochemicals for Monitoring and Control of Vegetable Crop Pest Insects

Beltsville, MD

September 24, 1992

National
Program
Staff

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Preface

Several of the major responsibilities of the ARS National Program Staff (NPS) are the assessment of the scope of current research addressing national issues, including systematic planning and documentation of research programs, identification of gaps, establishment of research priorities and resource needs, program evaluation, and the identification of the need for workshops to discuss emerging research needs and their relationship to the ARS planning process. In terms of these lead responsibilities, a one-day workshop was held to discuss the development of semiochemicals for use in monitoring and control of insect pests in vegetable crops.

The workshop's objectives were to determine the current status in the development of vegetable insect control semiochemical technology and technology transfer, to evaluate progress, and to provide a forum for discussing problems and possible solutions in terms of the application of semiochemical technology. The key insects selected for discussion were the pepper weevil, diamondback moth, pickle worm, stink bugs, sweetpotato weevil, Heliothis sp. (corn earworm), Diabrotica sp. (corn rootworm), tomato pinworm, and the Mexican rice borer. The NPS requested a contingent of eleven ARS scientists from 6 locations, along with their industry cooperators, to give brief summaries of the problem and to lead discussions centered around the workshop's objectives. We believe the meeting was most productive and a number of implementable recommendations were generated as a result of the day-long discussions.

The National Program Staff expresses its gratitude and appreciation to all workshop attendees for their time and participation in this most productive activity. We are especially indebted to the representatives from the industry for their attendance and their valuable interactions and contributions to the discussions. Industry is considered an important component of this team effort.

Robert M. Faust
National Program Leader
Fundamental and Molecular Entomology
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James R. Coppedge
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I. EXECUTIVE SUMMARY

A number of noxious insects such as the pepper weevil, diamondback moth, pickle worm, stink bugs, rootworms, sweetpotato weevil, corn earworm, tomato pinworm and the Mexican rice borer are considered serious pests of vegetable crops and pose increasing problems for control by producers. These insects continue to develop resistance to many of the current control methods that rely upon organic chemical insecticides; the safety of these chemicals continues to be questioned, especially in terms of food safety, residue problems, and in general the overall impact on the environment, nontarget organisms and human health. Insect semiochemicals have enjoyed increasing attention as feasible and environmentally compatible tools for pest management systems.

An ARS workshop devoted to semiochemicals for monitoring and control of vegetable crop pest insects was held on September 24, 1992, in Beltsville, MD. The purpose of the workshop was to: (1) Provide an assessment and evaluation of the status for use of semiochemicals for monitoring and control of specific vegetable insect pests in terms of the current status of semiochemical monitoring and control systems, the current status and future outlook for technology transfer of developed and developing methodology, the problems that have emerged for implementation of the technology, and solutions to problems for implementation of the technology; (2) Define work plans for the coming year and identify investigators who can help resolve problems to the use of semiochemicals for monitoring and control of vegetable insect pests.

High priority research needs and ARS locations that might address those needs were identified for each specific vegetable insect pest:

(a) Pepper weevil -- pepper weevil ecology and behavior; formulation of pheromone; trap design; importance of plant volatiles (Weslaco; Gainesville; Peoria).

(b) Diamondback moth -- influence of parasites/predators; system dynamics; development of plant attractants (Gainesville).

(c) Pickle worm -- forecasting methodology/monitoring systems for infestations; usable formulation and dispenser for longevity of pheromone aldehyde; available source of synthetic pheromone for testing; improved "box" trapping system; use of floral attractants/host-plant volatiles (Beltsville; Charleston; Industry).

(d) Stink bugs -- large scale methodology for use to attract and augment beneficial control agents and to lure beneficials from infestations prior to pesticide application; importance of plant volatiles to aggregation (Beltsville).

(e) Diabrotica (corn rootworm) -- Use of control methodology for cantelope and melon (Brookings; Lane; Pacific Biocontrol).

(f) Sweetpotato weevil -- determine appropriate context in which to use traps as applied to weevil free zones; identify volatile attractant/develop attractant-pheromone methodology for survey/detection and population suppression (toxic bait formulations) (Gainesville).

(g) Heliothis sp. (corn earworm) -- knowledge in terms of ecosystem influences on behavior and migration; parameters for use of an adult attracticide; mating disruption technology (Albany; Beltsville; College Station; Gainesville).

(h) Tomato pinworm -- mating disruption system/trap monitoring (currently working effectively) (Consep, Inc.).

(i) Mexican rice borer -- studies on behavior and biology; access to application technology (College Station; Consep, Inc.).

The future outlook of effective technology transfer will depend on close coordination and cooperation between the Federal research section and industry.

II. Objectives and Charge to the Workshop

The objectives and charge to the Workshop were to:

1. Provide an assessment and evaluation of the status of semiochemicals for monitoring and control of specific vegetable insect pests in terms of the following questions --

    a. What is the current status of semiochemical monitoring and control systems for each specific insect pest?

    b. What is the current status and future outlook for technology transfer of developed and developing methodology?

    c. What problems for implementation of the technology have emerged?

    d. How can problems to implementation of the technology be best overcome?

2. Define future work plans and identify investigators who might help address identified needs to facilitate the development and use of semiochemicals for monitoring and control of vegetable insect pests.

III. Reports' Synopsis, Identified Needs, and Investigators

A. Pepper Weevil

Synopsis

The pepper weevil, a relative of the boll weevil, is a serious pest for the peppers industry. The pepper weevil can cause extensive economic damage in relatively low numbers making sampling for this pest a challenge. The male weevil produces an aggregation pheromone which consists of six components. Pepper plants, when damaged by weevil feeding, release a volatile (Z)-3-hexenyl acetate along with several other volatiles. These volatiles could be candidates for use as attractants in the field. Both Trece, Inc. and ARS are interested in developing a commercially-viable monitoring tool for the pepper weevil.

Scientists in the ARS Bioactive Constituents Research Unit, NCAUR in Peoria, IL have isolated and identified the series of compounds emitted by the male pepper weevil. In initial field tests with a synthetic pheromone it was demonstrated that (1) it is possible to capture pepper weevils using boll weevil traps, (2) a synthetic pheromone results in an overall increase in trap catch, compared with the controls, (3) a blend of components is needed for good trap catches, and (4) a release rate 3-10 times that from a single pepper weevil male was the most effective, and it is not clear whether rubber septa are as effective as the use of teflon capillaries as carriers. An additional pheromone formulation is being developed in cooperation with the Plant Polymer Research Unit at NCAUR.

Subsequent to the workshop, field tests in Texas and California have demonstrated that sticky traps with the proper adhesive are far superior to the boll weevil trap in capturing pepper weevils. Using these traps and the identified 6-component pheromone blend, formulated by the process developed at NCAUR, trap catches have been more than 20 times higher than control sticky traps and more than 20 times higher than boll weevil traps baited with pheromone. Thus, formulation and trap configuration serve as a useful basis for further improvements of the system.

Identified Needs

ARS scientists feel that further improvements to the bait formulation are desirable. These include dose, field stability, possible inclusion of plant volatiles to enhance attractiveness, and deletion of any pheromone components not found to be necessary for optimal attractiveness. Studies of weevil ecology and behavior would be useful to suggest further trapping system improvements and would help with the interpretation of trap catch data with respect to the economic considerations of the growers.

Investigators

Fred Eller, Robert Bartelt, and Baruch Shasha (ARS)	Peoria, IL
Bill Lingren (Trece, Inc.)	Salinas, CA
Everett R. Mitchell and Robert Heath (potential) (ARS)	Gainesville, FL

B. Diamondback Moth

Synopsis

The diamondback moth is a worldwide pest of crucifers and is reported resistant to 36 insecticides in 14 countries. Attempts to control this serious pest adequately has failed in the states of Florida, Georgia, North Carolina, Texas, Wisconsin, and New York since 1985. Resistance to the insecticidal crystal protein of Bacillus thuringiensis subsp. kurstaki has been demonstrated by researchers in the Phillipines, Hawaii, Florida and New York, and there has been anecdotal reports of resistance to benzoylphenylureas (IGRs) in Thialand. Development of alternative control options, such as host-plant resistance, plant attractants and repellants/deterrents will likely require long term research efforts. Alternative control measures with a more immediate promise include the development and use of biological control agents, sterile insect techniques, and mating disruption.

The female sex pheromone of the diamondback moth was characterized in 1977 by Japanese researchers and a refined pheromone trap has been developed by Canadian scientists. There is also evidence of a male sex pheromone. Other semiochemicals that have been studied include (a) allylisothiocyanate which arrests larvae, accelerates sexual maturation, and enhances oviposition, (b) glucosinolates that stimulate larval feeding and oviposition, and (c) rutin and cumarin, which deter oviposition. Other studies indicate that the presence of certain host plants (mustard) increases the rate of female sexual maturation and that males and especially females are attracted to plant volatiles.

Mating disruption on a commercial scale using sex attractants has been reported by Japanese scientists and by ARS scientists in Florida. Several anecdotal reports indicate that non-specific feeding stimulants can be used to enhance the effects of B. thuringiensis and other pesticides (COAX, Gustol, Entice). An ARS laboratory in Gainesville, FL is developing an integrated pest management system based on mating disruption technology. The major target commodity is cabbage. Formulations include baits and disruptants (an EPA permit has been obtained for field testing); grower acceptance and industry interest appears high, but cost factors and the role of other pests (cabbage looper, aphids, whiteflies) need consideration. Also, there is a need to monitor the influence of parasites and predators.

Identified Needs

Studies on the influence of parasites and predators, system dynamics, and the development of plant attractants would be useful for the development of an IPM system for control of the diamondback moth. A more user friendly formulation is needed for mating disruption.

Investigators

Everett R. Mitchell (ARS)	Gainesville, FL
John R. McLaughlin (ARS)	Gainesville, FL
Pacific Biocontrol	Davis, CA
Micro Flo Co.	Lakeland, FL

C. Pickle Worm

Synopsis

The pickle worm is a serious pest of curcubit fruit with the larvae boring holes inside of the cucumber and into the stem; in wild cucumbers high populations often occur. The pest overwinters in South Florida and in the spring moves northward. A female sex pheromone has been identified and its structure is known. There is an urgent need for forecasting methodology for pickle worm infestations since an entire crop is endangered if left uncontrolled, and economic inputs are wasted if treatments are pursued when, in fact, the pickle worm may not be present. Research on trap designs is needed as well as development of usable formulations. All components of the pheromone are absolutely essential; availability of synthetic pheromone for field tests hinders advances.

The American Pickle Packers Association has expressed an urgent need for a pickleworm monitoring system. Pheromone synthesis and stabilization is a desirable goal. A coordinated team effort between ARS scientists and industry is mandatory for developing an effective monitoring system.

Identified Needs

A forecasting methodology/monitoring system for pickleworm infestations is urgently needed, as well as a source of synthetic pheromone to conduct the necessary field tests; a usable formulation and dispenser that will protect the pheromone aldehyde, a redesigned economical box trap, and identification of possible floral attractants/host-plant volatiles are other important needs.

Investigators

Barbara A. Leonhardt (ARS)	Beltsville, MD
Jerome A. Klun (ARS)	Beltsville, MD
James E. Oliver (ARS)	Beltsville, MD
Kent D. Elsey (ARS)	Charleston, SC
Industry (Hercon, Inc.)	York, PA

D. Stink Bugs

Synopsis

Several stink bug genera are serious pests of vegetable crops including Nezara, Acrosternum, Euschistus, and Thyanta, all of which respond to pheromones and kairomones with the exception of Thyanta for which a kairomone attractant has not been identified. Work by ARS scientists in Beltsville, MD have led to the identification of kairomones for stink bug egg parasitoids (e.g., Trissolcus basalis). The male native stink bug, Acrosternum hilare and the male southern stink bug, Nezara viriduda produce pheromones that cause aggregation. Blends of male pheromone components may be important for species specificity.

One important predatory stink bug is the spined soldier bug, Podisus maculinentris; an attractant pheromone is commercially available.

Strategies for using semiochemicals in stink bug control include attracting beneficial insects to infestations (augmentation) and luring beneficials from infestations prior to pesticide application (conservation). Plant volatiles may also be important in management tactics.

Identified Needs

Pheromone/kairomone attractants of egg parasitoids/predators are needed as well as large scale methodology for use to attract and augment beneficials and to lure beneficials from infestations prior to pesticide application; the importance of plant volatiles to aggregation needs to be defined.

Investigators

Jeffrey R. Aldrich (ARS)	Beltsville, MD

E. Diabrotica sp. (corn rootworm)

Corn rootworms cause billions of dollars of losses to the corn industry. The ARS laboratory in Brookings, SD has been working with industry in the development of adult attracticides using a feeding stimulant and a toxicant, which has been registered by EPA on corn and other vegetable crops.

Identified Needs

Use of control methodology for cantelope and melon.

Investigators

Gerald R. Sutter (ARS)	Brookings, SD
Sammy Pair (ARS)	Lane, OK
Pacific Biocontrol	Davis, CA

F. Sweetpotato Weevil

Synopsis

The sweetpotato weevil is considered a major pest for much of the world, and novel detection and control methods are needed. The development of the sweetpotato weevil sex pheromone by ARS scientists in Gainesville, FL was a major breakthrough that allowed trapping of male sweetpotato weevils. This discovery has increased significantly the ability to detect low populations of this pest. Accurate delimitation of weevil-infested and weevil-free areas is crucial for efficient production and marketing of sweet potatoes, and pheromone traps should be of use in addressing this problem.

While use of the pheromone in its present form allows for detection of weevils, other important questions are raised by its use. The Southern Plant Board has passed resolutions requesting that research be conducted to help answer some of these questions. Specifically, the Commissioners of Agriculture from member states of the Southern Plant Board request ARS assistance to (1) identify, coordinate, and conduct the research necessary to establish the parameters for practical field use of sweetpotato weevil sex pheromone traps, and (2) identify an attractant for the female sweetpotato weevil. Development of a low release pheromone formulation for male sweetpotato weevils would enable detection of this pest in limited areas such as on-farm sites and in storage facilities without attraction of weevils into these areas from distant sources. Identification of an attractant for sweetpotato weevil females would greatly enhance survey and detection of this pest and also would likely provide a means for suppression of low level weevil populations on sweet potato and wild hosts.

Identified Needs

Research is needed to determine how to use the pheromone in any kind of pest management strategy, i.e., determine the appropriate context in which to use traps as applied to weevil free zones; research is also needed to identify chemicals derived from sweetpotato that are attractive to both females and males for use in combination (pheromone-plant attractant) as survey and detection tools, and in population suppression using various tactics such as mass annihilation by trapping or by the spread of toxic bait formulations over selected areas.

Investigators

Everett R. Mitchell (ARS)	Gainesville, FL
Robert R. Heath (ARS)	Gainesville, FL
James Coffelt (ARS)	Gainesville, FL

G. Heliothis sp. (corn earworm)

Synopsis

Heliothis sp. have a world-wide distribution and are some of the most serious pests to agriculture. Heliothis zea, a migratory insect, is a particularly troublesome pest on corn. The Heliothis/Helicoverpa complex itself cost growers about $2 billion annually in yield losses and control costs. Currently, their control is achieved almost entirely through the use of synthetic organic insecticides.

The desire to effectively manage Heliothis sp. using integrated control strategies that reduce pesticide dependency continues as an ARS primary focus; semiochemicals are particularly attractive for this effort. One long-range critical research area being addressed is the development and implementation of methods for using kairomonal compounds derived from plants such as Gaura longiflora, Ergot, and Gaura drummondii to suppress corn earworm in vegetable cropping situations through direct control of adults. Recent research by ARS scientists has demonstrated that plant-derived kairomones play a significant role in the feeding and reproductive behaviors of Heliothis sp. (and their parasitoids). The use of pheromones and plant kairomones offer extraordinary potential for management of these pests on a variety of vegetable as well as other crops.

Identified Needs

Knowledge is needed in terms of ecosystem influences on behavior and migration; identification of parameters for use of an adult attracticide is a critical need; mating disruption technology needs to be developed.

Investigators

Peter D. Lingren (ARS)	College Station, TX
Don L. Bull (ARS)	College Station, TX
Barbara A. Leonhardt (ARS)	Beltsville, MD
Roy Terinishi (ARS)	Albany, CA
Douglas M. Light (ARS)	Albany, CA
Everett R. Mitchell (ARS)	Gainesville, FL
John R. McLaughlin (ARS)	Gainesville, FL
Pacific Biocontrol	Davis, CA
Micro Flo Co.	Lakeland, FL

H. Tomato Pinworm

Synopsis

This insect pest infests varieties of tomatoes; it develops first in the foliage, then moves to the fruit. It is a significant pest in the western U.S. and Florida where cropping seasons are long and the winters are mild. It oversummers in southern California. In Florida, the tomato pinworm attacks eggplants.

ARS scientists in cooperation with Cornell University and the University of Florida identified the sex pheromone for tomato pinworm and developed the mating disruption technology. In 1982 a no-mate fiber semiochemical formulation was registered in the United States and Mexico, the latter being the major user. The first IPM program was initiated for processing tomatoes.

Tomato pinworm shows tolerance to the synthetic pyrethroids and heavy pesticide use contributes to human safety issues, especially in Mexico. Mating disruption system seems to be quite effective, and when used in an IPM system, it allows for a significant reduction in insecticide applications. Mating disruption systems seems to be quite effective, and when used in an IPM system, has allowed for a significant reduction in insecticide applications. Mating disruption systems are being developed for early season use.

Identified Needs

Longer lasting and user friendly disruptant formulations are needed; mating disruption system and trap monitoring seem to be an effective control measure.

Investigators

John R. McLaughlin (ARS)	Gainesville, FL
Janice Gillespie (Consep, Inc.)	Bend, OR
Everett R. Mitchell (ARS)	Gainesville, FL
Scentry, Inc.	Buckeye, AZ
Trece, Inc.	Salinas, CA

I. Mexican Rice Borer

Synopsis

The Mexican rice borer is a pest of sweet corn in southern Texas in the fall; it is also a major pest of sugar cane in the Rio Grande Valley where losses and cost of control amounts to $4 million annually. The sex pheromone of the Mexican rice borer was isolated in 1983; it consists of three components. The phermone is used in trapping systems along with a slow release formulation (rubber septa). Mating disruption tests in 1988-89 resulted in a 81-95% decrease in mating. Rubber chips impregnated with the pheromone (and then rubber septa) were used in 1990 in field tests with only 5% damage to the crop as compared with untreated controls, which had 19% damage. In 1991 a polyvinyl chloride formulation was developed which was effective for 100-110 days and resulted in substantial reduction in crop damage.

Identified Needs

Studies are needed on Mexican rice borer behavior and biology; access to application technology is needed.

Investigators

Peter D. Lingren (ARS)	College Station, TX
Consep, Inc.	-

IV. APPENDICES

APPENDIX A. Workshop Agenda

Semiochemicals for Monitoring and Control of Vegetable Crop Pests
September 24, 1992
Bldg. 005, Rm. 4
Beltsville, Maryland

WORKSHOP AGENDA

Morning Session

8:15- 8:30 am	Welcome and Introductory Remarks	R. Faust
8:30- 8:45 am	Purpose of meeting & charge to workshop	J. Coppedge
8:45- 9:00 am	Technology Transfer of Pheromones	R. Parry
9:00- 9:30 am	Pepper weevil	R. Bartelt
9:30-10:15 am	Diamondback moth	J. McLaughlin
10:15-10:30 am	Break	
10:30-11:15 am	Pickle worn	K. Elsey
12:00- 1:00 pm	Lunch break	

Afternoon Session

1:00- 1:45 pm	Stink bugs	J. Aldrich
1:45- 2:30 pm	Sweetpotato weevil	E. Mitchell
2:30- 2:45 pm	Break	
2:45- 3:30 pm	*Heliothis* sp. (corn earworm)	P. Lingren
3:30- 4:00 pm	Tomato pinworm	J. Gillespie/Others
4:00- 4:30 pm	Mexican Rice Borer	P. Lingren
4:30- 4:45 pm	*Diabrotica* sp. and other pests	Group
4:45- 5:00 pm	Wrap-up	R. Faust & J. Coppedge

Adjourn

APPENDIX B. List of Attendees

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APPENDIX C. List of Semiochemical Patents by ARS Inventors

PATENT: 4,871,537 (S.N. 07/207,591), "6,12-Dimethylpentadecan-2-one and Its Use in Monitoring and Controlling the Banded Cucumber Beetle"

INVENTORS: J. McLaughlin; J. Tumlinson; R. Doolittle; T. Chuman; P. Guss

ABSTRACT: A pheromonal compound produced by the banded cucumber beetle has been identified as 6,12-Dimethylpentadecan-2-one. Both the synthetically prepared racemic compound and the purified natural pheromone elicited responses by banded cucumber males in field tests. By attracting adult beetles to field traps, this compound is a useful tool for the monitoring and controlling of this major agricultural pest.

LICENSING ACTIVITY: Available for licensing.

PATENT: 4,732,756 (S.N. 06/879,696), "(Z)-3-Dodecen-1-OL (E)-2-Butenoate and Its Use in Monitoring and Controlling the Sweetpotato Weevil"

INVENTORS: R. Heath; J. Coffelt; F. Proshold; P. Sonnet; J. Tumlinson

ABSTRACT: A pheromonal compound produced by the sweetpotato weevil has been identified as Z)-3-Dodecen-1-OL (E)-2-Butenoate. The synthetically-prepared compound demonstrates activity toward the sweetpotato weevil comparable to or greater than that of the natural female and comparable to that of its natural counterpart under field conditions. The novel compound provides a sensitive tool for detection of the sweetpotato weevil. By attracting adult weevils to field traps, this compound provides a means for monitoring and controlling this major agricultural pest.

LICENSING ACTIVITY: Licensed to AgriSense - 1/27/89.

PATENT: S.N. 07/662,601, "Green Leaf Volatiles as Synergists for Insect Pheromones"

INVENTORS: J. Dickens; R. Billings; T. Payne

ABSTRACT: A composition for preventing or limiting the attack and infestation of trees by pine bark beetles, by inhibiting the response of the beetles to their aggregation pheromones. The composition comprises a green leaf volatile selected from six carbon alcohols, aldehydes, their derivatives such as acetates, and mixtures thereof. The green leaf volatile may be employed alone or in combination with an additional known inhibitor of the pheromone response of the beetles.

LICENSING ACTIVITY: Exclusive license application has been received. Decision expected by November 1992.

PATENT: 4,632,829 (S.N. 06/785,639), "Sex Pheromone Composition for Southwestern Corn Borer"

INVENTORS: P. Hedin; F. Davis; J. Dickens; M. Burks; T. Bird

ABSTRACT: A sex pheromone composition for southwestern corn borer male moth consisting essentially of Z9-Hexadecenal in an amount of about 16-26% by weight, Z11-Hexadecenal in an amount of about 56-85% by weight, and Z13-Octadecenal in an amount of about 6-10% by weight.

LICENSING ACTIVITY: Available for licensing.

PATENT: 5,032,576 (S.N. 07/354,326), "Peptides Stimulating Sex Pheromone Production and Melanization in Moths" related case 07/730,453

INVENTORS: A. Raina; H. Jaffe; T. Kempe

ABSTRACT: A pheromone biosynthesis activating neuropeptide (Hez-PBAN) hormone, controlling sex pheromone production in moths and controlling melanizing in larvae, was isolated from the brain-subesophageal ganglion complexes of adult corn earworm Heliothis zea. Hez-PBAN has 33 amino acids residues and a molecular weight of 3900; its amino acid sequence is unique among the fully characterized peptide hormones. Synthetic PBAN and related structures induced production of sex pheromone in ligated H. zea females and other moth species and melanization in larvae that resulted in morphological changes or death.

LICENSING ACTIVITY: ARS licensed USDA share to University of Maryland on 2/6/90. Maryland licensed to Penninsula Lab, Belmont, California, on a nonexclusive basis. Penninsula Labs had sales in July 1991.

PATENT: 5,011,683, (S.N. 07/275,863), "Aggregation Pheromones of the Driedfruit Beetle, Carpophilus hemipterus"

INVENTORS: R. Bartelt; P. Dowd

ABSTRACT: A male-produced aggregation pheromone was demonstrated in Carpophilus hemipterus (L.) (Coleoptera: Nitidulidae) using a wind-tunnel bioassay. The attractiveness of the pheromone is greatly enhanced by volatiles from a host plant, and combinations of pheromone and food volatiles typically attract 3-10 times more beetles than either source by itself. The pheromone consists of a series of 13-, 14-, and 15-carbon unsaturated hydrocarbons, the most abundant of which is 3,5,7-trimethyl-(E,E,E,E)-2,4,6,8-decatetraene.

LICENSING ACTIVITY: Patent issued April 1991. Available for licensing.

PATENT: 4,877,607, (S.N. 07/247,546), "Attractants for Dacus Latifrons, the Malaysian Fruit Fly"

INVENTORS: T. McGovern; R. Flath; R. Cunningham

ABSTRACT: Certain cyclohexyl and cyclohexyl aliphatic alcohols and ketones are potent attractants for Dacus latifrons, the Malaysian fruit fly. By attracting adult males to field traps, the compounds provide a means for detecting, monitoring and controlling this agricultural pest.

LICENSING ACTIVITY: Licensed to AgriSense by ARS on 6/21/91. AgriSense reported low priority in development 3/12/92.

PATENT: 4,931,032, (S.N. 07/247,547), "Octadienyl Acetate Synergist for the Grape Root Borer Pheromone"

INVENTORS: M. Schwartz; J. Klun; J. Snow

ABSTRACT: Addition of (Z,Z)-3,13 octadecadienyl acetate to the grape root borer, Vitacea polistiformis (Harris), pheromone (E,Z)-2,13 octadecadienyl acetate increases capture of males in sticky traps by three to sevenfold. This new composition will provide an effective system for monitoring and controlling the grape root borer.

LICENSING ACTIVITY: Available for licensing.

PATENT: 4,600,581, (S.N. 06/681,394), "Synthetic Pheromones for the Spined Soldier Bug, Podisus"

INVENTORS: J. Aldrich

ABSTRACT: A synthetic pheromone formulated chemicals found in the airborne secretion of Podisus maculiventris, the spined soldier bug, was found to be highly effective in attracting P. maculiventris, a beneficial predatory insect, to desired areas for biological control of pests.

LICENSING ACTIVITY: Licensed to Sterling International - 7/5/89; Commercially available since the spring of 1991 under the name Soldier Bug Attractor™

PATENT: 4,527,000

INVENTORS: J. R. McLaughlin; D. A. Carlson

ABSTRACT: Novel diolefin insect pheromone mimics are used to disrupt the sexual communication between insects when applied to an agricultural area in behaviorally effective amounts as follows: (Z)-1,12 heptadecadiene used for Heliothis zea (Boddie); (Z)-15-methyl-1,9-heptadecadiene used for Trogoderma variabile; (E)-15-methyl-1,9-heptadecadiene used for Trogoderma glabrum; and (Z,Z)-1,12,14-heptadecatriene used for Amevlois transitella.

LICENSING ACTIVITY: Available for Licensing.